PRELIMINARY ANALYSIS OF PIT CRATERS ON ALBA PATERA, MARS USING MOC DATA. K.E. Venturini, K.M. Jager and K.J. Savasta, Community College of Rhode Island, Department of Physics, Lincoln RI, 02865 USA, (Dudepeaceman@aol.com)

Introduction: Chains of pit craters, also known as catenae, are found on Mars, many of them visible within graben on the eastern flanks of Alba Patera. Alba is a large, low relief shield volcano whose edifice is asymmetrical but has an average diameter of 1200 km and is located on the northern flanks of the Tharsis Plateau [1,2]. Tanaka (1990) [3] determined that the majority of pits on Alba are located within the final stage of faulting on Alba, a stage that does not follow the same trend as the previous graben around the flanks. Two main theories have been developed to explain how these pit chains formed.

The first theory suggests that pits formed from underlying tension cracks extending the depth of the lithosphere [3,4,5]. The ground above these cracks collapsed, forming 2-10 km wide pits. These pits are not thought to be formed by volcanic processes because there is no evidence of volcanic deposits [4,6].

The second theory concerning pit chain formation involves the emplacement of shallow dikes in the Martian crust, producing surface graben [7,8,9]. These graben with pits are likely a result of the emplacement of dikes originating near the Tharsis Montes [10]. This second theory explains both the larger and smaller pits on Alba. The smaller pits formed when there was a surface collapse of rock layers into a void space, which was created by leaking volatiles from a subsurface dike when it stalled. The larger pits formed from collapsed surface material falling into the space provided by an explosive eruption of magma from a dike that approached the surface. Although volcanism is involved in the formation of the large pits, the flows are not seen because of the extreme dispersal of the erupted material [6].

In this paper we analyze pits on Alba Patera using Mars Orbiter Camera (MOC) images with resolutions of 1.60-6.53 m/pixel. Those images allow more refined values of the area and sizes of the pits. Mars Orbiter Laser Altimeter (MOLA) data were also used to determine pit depth and slopes. Pits studied in this paper are compared to pits studied by Scott and Wilson (2002) [6] on Alba Patera.

Methods: All pits on Alba Patera were located and mapped using Viking data (Figure 1). Next, we searched the 372 released MOC images of Alba and found 21 images of pits (Figure 1), with some images containing more than one pit. Of these images, we selected 20 pits for further analysis based on if the entire pit was located within the MOC image.

The diameter of the pits was measured on the MOC images perpendicular to and parallel to the direction of the graben. Some pits are circular, so both values are approximately the same, but some pits are elongate in the along-graben direction.

We analyzed individual MOLA profiles to obtain slopes of pits on Alba Patera. We were selective of the profiles we used, since many of them do not transverse the center of the pits, which leads to erroneously low slopes. Also, because MOLA has a horizontal resolution of 300-400 m [11], only the larger pits can be accurately measured for slopes.

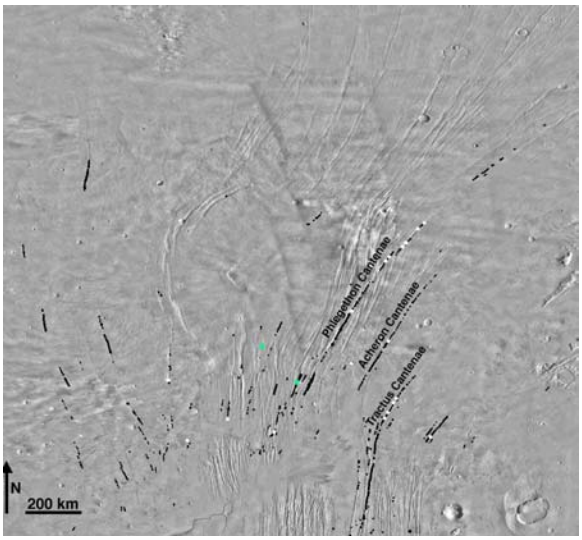

Figure 1: Viking Orbiter image of Alba Patera (25°-57°N, 90°-125°W). Black dots show all pits on Alba; white dots show 18 selected pits; green squares show the locations of Figures 2 and 3.

Discussion and Conclusion: After measuring twenty pits of varying size on Alba Patera, we determined that classifying these pits as either small or large is not a simple process. Scott and Wilson (2002) define small pits to be <2 km with simple, circular shapes, while large pits are 4-10 km and have complex shapes. We found that some pits have small sizes but irregular shapes, while others have larger sizes and more uniform shapes. Our explanation for the discrepancy is that MOC data have a higher resolution than Viking data, so more complex features can now be seen in the pits than could previously be seen.

Using the selected MOLA profiles of pits, we determined the average slopes (between the individual MOLA footprints) of the sides of the pits to be 18º. The pits are generally V-shaped although the slopes are less steep at the bottoms of the pits. In order to

estimate the volumes of the pits, we used our measured diameters from the MOC images, assumed a conical shape, and applied the average slope of 18º to all pits. These are valid simplifications based on analysis of the MOLA data, although they may slightly overestimate the volume of the pits.

We calculated volumes of the twenty pits and these values ranged between 0.02 km^3 and 1.14 km^3, with an average volume of 0.32 km^3. These pits could be classified as small simply because their volumes are less than ~2 km^3, even though many of these pits have irregular shapes.

We also examined the MOC images for signs of volcanic eruptions from the pits. Because the MOC images have a much higher resolution than Viking images, it may be possible to detect evidence of volcanics erupted from the pits. We did not find any evidence; however, our analysis is mostly of small pits. Therefore, we cannot draw conclusions as to the importance of volcanic eruptions in the formation of the larger pits.

Scott and Wilson (2002) analyzed pits along an 85 km-long segment of Acheron Catena on the eastern flanks of Alba Patera. Of the thirty small pits studied, none have a diameter >2.0 km. Of the twenty pits we chose, seven exist on Phlegethon Catena, a pit chain located 130 km to the west of Acheron Catena. Although the pits that we analyzed on Phlegethon Catena are, on average, larger than the pits on Acheron Catena, they are still considered small pits and therefore formed in the same way as the small pits.

Our analysis of pit craters using MOC images demonstrates the complexity of the pits compared to what is seen in Viking images. We measured diameters of the pits and, using an average slope derived from MOLA data, calculated their volumes. Our values are consistent with those calculated by [6]. We did not find evidence of volcanics from the pits, but this is not contrary to the theory of pit formation proposed by Scott and Wilson (2002).

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Figure 2: Simple pit with a diameter (measured NW-SE) of 1.93 km. This is classified as a small pit because of its shape and size. MOC image M09-05624; 3.05 m/pix; image width is 2.11 km.

Figure 3: Complex pits with the upper pit having a diameter (measured NW-SE, perpendicular to the graben direction) of 1.37 km. This can be classified as a large pit because of its shape, although it is small in size. MOC image E12-01810; 6.43 m/pix; image width is 3.27 km.